TUESDAY, 16 NOVEMBER 1976 SUNSET ROOM, 9:00 A.M.

Session D. Architectural Acoustics I: Room Acoustics and Sound Isolation

Ronald L. McKay, Chairperson

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Contributed Papers

9:00

D1. Lecture room in Hunt Hall (formerly the Fogg Art Museum), Harvard University—An historical review. Ewart A. Wetherill (Bolt Beranek and Newman Inc., Cambridge, MA 02138)

At the 86th meeting of the Acoustical Society of America, the author reviewed the history of Hunt Hall—the building where W.C. Sabine began his studies of architectural acoustics—and reported his acoustic measurements of the lecture room immediately before its demolition in June 1973. Subsequent investigation has answered some unresolved questions and has yielded further information, summarized here.

9:30

D2. Concert hall measurements during musical performances. M.R. Schroeder and W.J. Möller (Drittes Physikalisches Institut, Universität Göttingen, F.R. Germany, and Bell Laboratories, Murray Hill, NJ 07974)

Most acoustical measurements of concert halls are made in unoccupied halls. This paper describes how to use the music signal, recorded by microphones on the stage during a musical performance, as a test signal to measure reverberation time, early and late energies ("clarity"), modulation transfer functions, pronounced echoes and other perceptually important aspects of the hall's impulse response.

9:45

D3. Unique Properties of an Open-Plan Auditorium. Rein Pirn and Jeffrey E. Bollinger (Bolt Beranek and Newman Inc., 1740 Ogden Ave., Downers Grove, IL 60515)

An architecturally open concept was adopted in the design of a 500-seat auditorium for a new school. The audience is seated on four shallow tiers that are adaptable for dining. The space is distinguished by a tall well over the forward seats, beyond which the ceiling is very low. At the back and sides, the arena is open to the student commons. Above and behind the stage, it is open to a spacious mezzanine. Deliberate acoustical provisions include absorptive finishes, lockers that act as barriers, a retractable curtain in place of a rear wall, reflectors to help stage-audience communication, and controlled background noise. Investigations reveal several unique properties: short but remarkably uniform reverberation times, averaging 0.72 sec; distance-depedent loudness that imparts a sense of dissimilar room size, depending on seat location; excellent intelligibility of stage sounds, with an average AI of 0.91 for raised voice; and excess attenuation of extraneous sounds on the order of 10 dB.

10:00

D4. Image method for efficiently simulating small-room acoustics. J.B. Allen and D.A. Berkley (Acoustics Research Department, Bell Laboratories, Murray Hill, NJ 07974).

Image methods have been successfully used in the analysis of the acoustic properties of enclosures for the purpose of architectural design. In this paper we disuss use of image techniques for simulating the impulse response between two points in a small room. The resulting response is then convolved with any desired input signal and the reverberated output used for signal processing or psychoacoustic studies. The entire process is carried out using a digital computer so that wide ranges of parameters can be simulated with perfect control over experimental conditions.

10:15

D5. Sound transmission between absorbing parallel planes. C.J. Hurst and L.D. Mitchell (Department of Mechanical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061)

Partially absorbing parallel surfaces can be dominant acoustical feature of many rooms. The sound fields in such rooms are not diffuse, which causes difficulty in predicting sound pressure levels. A method is developed for predicted sound pressure levels in these rooms. It rests on the prediction of sound pressure levels caused by a nondirectional source of known sound power radiating between absorbing parallel planes. The development proceeds from a geometrical acoustics viewpoint. Good correlation has been found between predicted and measured levels in existing rooms having simple geometries. [Work supported by NSF.]

10:30

D6. Perceptual factors of small room reverberation. Barbara McDermott and Jont Allen (Bell Laboratories, Murray Hill, NJ 07974)

Room reverberation has a well recognized characteristic quality which can be annoying in a conference telephony environment. The subjective factors of reverberent speech were studied by asking listeners to judge speech samples in which the short-term and long-term reverberation times the independent variables. Synthetic room impulse responses were generated on a digital computer based on an image model of a room. Four microphone-loudspeaker distances were combined with four wall adsorption coefficients, giving a total of 16 distinct room conditions. Speech samples consisting of ten sentences spoken by each of four talkers were reverberated by the 16 room conditions. All possible pairs of the 16 room conditions were presented to listeners for judgment. The subjects were asked to use a scale from zero to nine to report how different they thought the speech sounded in each pair of rooms. These data were analyzed by a scaling procedure that relates the difference judgments to a distance in a multidimensional perceptual space (INDSCAL). Our success in relating physically measured variables derived from the impulse responses to the factors of the perceptual space will be discussed.

10:45

D7. Acoustic environment for audio teleconferencing. R. Botros (Bell-Northern Research, P.O. Box 3511, Station C, Ottawa, Ontario, Canada K1Y 4H7)

In contrast to handset telephony, the acoustic environment plays an important role in handsfree (loudspeaking) telephony and more significantly in audio teleconferencing. With increasing distance between talker and telephone terminal, the effects of room resonances, reverberance and background noise on the quality of speech telecommunication became more and more critical. The range of variation of these parameters